CLAIMS

Therefore, the following is claimed:

1. A micro electro-mechanical device packaging system, comprising:

a micro electro-mechanical device formed on a substrate layer; and

a protective structure protecting at least a portion of the micro electro-mechanical device, wherein the protective structure is formed on the substrate layer and surrounds a gas cavity enclosing an active surface of the micro electro-mechanical device, the protective structure being a solid.

2. The system of claim 1, wherein the substrate layer comprises silicon material.

3. The system of claim 1, wherein the substrate layer comprises non-silicon material.

4. The system of claim 1, wherein the protective structure comprises a metal material.

5. The system of claim 4, wherein the metal material is deposited by sputtering.

6. The system of claim 1, wherein the protective structure comprises an overcoat polymer material.

7. The system of claim 6, wherein the overcoat polymer material is deposited by spin-coating.

8. The system of claim 6, further comprising:

an additional protective structure surrounding the overcoat polymer material.

9. The system of claim 8, wherein the additional protective structure comprises a metal material.

10. The system of claim 1, wherein the protective structure comprises a modular polymer that includes the characteristic of being permeable to the decomposition gases produced by the decomposition of a sacrificial polymer while forming the gas cavity.

11. The system of claim 1, wherein the gas cavity is substantially free of residue.

12. The system of claim 11, wherein the gas cavity is vacuum-packed.

13. The system of claim 1, wherein protective structure has not been preformed before being applied to the substrate layer.

14. The system of claim 13, further comprising:

a metal packaging frame, the micro electro-mechanical device being attached to the metal packaging frame; and

a coating material encapsulating a portion of the micro electro-mechanical device and metal packaging frame assembly.

15. A micro electro-mechanical device packaging system, comprising:

a micro electro-mechanical device formed on a substrate layer; and

a thermally decomposable sacrificial structure protecting at least a portion of the micro electro-mechanical device, wherein the sacrificial structure is formed into a gas cavity enclosing an active surface of the micro electro-mechanical device.

16. The system of claim 15, wherein the sacrificial structure comprises a photo-definable polycarbonate material.

17. The system of claim 15, wherein the sacrificial structure is deposited by spin-coating followed by patterning.

18. The system of claim 17, wherein the sacrificial structure comprises a photo-definable material.

19. The system of claim 15, wherein the sacrificial structure is dispensed by a syringe dispensing tool.

20. The system of claim 19, wherein the sacrificial structure comprises a non-photo-definable material.

21. The system of claim 15, further comprising:

a metal packaging frame, the micro electro-mechanical device being attached to the metal packaging frame; and

a coating material encapsulating a portion of the micro electro-mechanical device and metal packaging frame assembly, the coating material including the characteristic of being permeable to the decomposition gases produced by the decomposition of a sacrificial polymer at a temperature exceeding a curing temperature of the coating material.

22. The system of claim 21, wherein the coating material comprises an epoxy resin.

23. The system of claim 21, further comprising:

an overcoat structure surrounding the sacrificial structure, the overcoat structure comprising a modular polymer that includes the characteristic of being permeable to the decomposition gases produced by the decomposition of a sacrificial polymer from inside the gas cavity.

24. A method for producing a micro electro-mechanical device package, comprising the steps of:

forming a thermally decomposable sacrificial layer on a substrate of a micro electro-mechanical device, the sacrificial layer encapsulating a portion of the micro electro-mechanical device;

forming a protective layer around the sacrificial layer; and

thermally decomposing the sacrificial layer, wherein decomposed molecules of the sacrificial layer permeate through the protective layer, and wherein a gas cavity is formed where the thermally decomposable sacrificial layer was formed.

25. The method of claim 24, further comprising the steps of:

depositing the sacrificial layer by spin-coating; and

patterning the sacrificial layer.

26. The method of claim 24, wherein the sacrificial layer has a decomposition temperature less than a decomposition temperature of the substrate and a decomposition temperature of the protective layer.

27. The method of claim 24, wherein the substrate comprises a silicon material.

28. The method of claim 24, wherein the substrate comprises a non-silicon material.

29. The method of claim 24, wherein the thickness of the protective layer is within the range of 50 nm and 500 μm.

30. The method of claim 24, wherein the protective layer has not been perforated.

31. The method of claim 24, wherein the protective layer is substantially free of sacrificial material after the sacrificial material has been thermally decomposed.

32. The method of claim 24, wherein the protective layer provides an airtight enclosure around the gas cavity.

33. The method of claim 32, wherein the protective layer provides protection from mechanical forces.

34. The method of claim 33, wherein the protective layer further provides protection against water.

35. The method of claim 34, wherein the protective layer further provides protection against oxygen gas.

36. The method of claim 34, wherein the protective layer further provides protection against exposure to gaseous materials.

37. The method of claim 24, wherein the micro electro-mechanical device includes a released mechanical structure before the sacrificial material is formed.

38. The method of claim 24, further comprising the steps of:

before the protective layer is formed, attaching the micro electro-mechanical device to a metal packaging frame, wherein the protective layer comprises an epoxy resin encapsulating the micro electro-mechanical device and metal packaging frame assembly.

39. The method of claim 38, further comprising the step of:

heating the micro assembly at a temperature for curing the protective layer; and

heating the micro assembly at a temperature for decomposing the sacrificial layer, the temperature for decomposing the sacrificial layer exceeding the temperature for curing the protective layer.

40. The method of claim 24, further comprising the step of:

forming a barrier layer around the protective layer, the barrier layer providing a stronger protection against mechanical forces than the protective layer.

41. The method of claim 40, wherein the barrier layer comprises a metal material.

42. The method of claim 40, further comprising the steps of:

creating a vacuum inside the gas cavity by heating the micro electro-mechanical device in a chamber; and

after the vacuum is created, forming a barrier layer around the protective layer within the chamber to provide a vacuum-packed enclosure around the gas cavity, the barrier layer comprising a metal material.

43. The method of claim 42, further comprising the steps of:

after the barrier layer is formed, attaching the micro electro-mechanical device to an integrated circuit package structure; and

encapsulating the electro-mechanical device and integrated circuit package structure in a protective coating.

44. The method of claim 42, wherein the integrated circuit package structure comprises a leadframe.

45. The method of claim 42, wherein the integrated circuit package structure comprises a ceramic package.

46. The method of claim 42, wherein the step of thermally decomposing the sacrificial layer occurs inside the vacuum chamber.

47. The method of claim 24, further comprising the steps of:

after the sacrificial layer is decomposed, attaching the micro electro-mechanical device to an integrated circuit package structure; and

encapsulating the electro-mechanical device and package structure in a protective coating.

48. The method of claim 47, wherein the integrated circuit package structure comprises a leadframe.

49. The method of claim 47, wherein the integrated circuit package structure comprises a ceramic package.

50. The method of claim 24, wherein thermal decomposition temperature of the sacrificial material is less than 100 degrees Celsius.